# Numerical simulation of anisotropic composite material properties under quasi-static, cyclic and dynamic loading

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The research is devoted to the development and experimental verification of the structural-phenomenological model of deformation and fracture of composite laminates. The developed model based on the introduction of the periodicity cell of the composite material has been carried out to determine the effective elastic moduli, deformation diagrams and strength characteristics for the case of tension and shear in the reinforcement plane. The model parameters were verified using sound velocity measurements. For cyclic loading, the numerical simulation was carried out taking into account the nonlinear kinetics of defects nucleation and growth in comparison with the S-N curve. The dynamic formulation of the problem was implemented for the Hopkinson–Kolsky test and shock-wave experiments. Numerical modelling has been performed in the Comsol Multiphysics application package using the finite element method for anisotropic elastic material, taking into account the nonlinear kinetics of defect growth in the composite material.
The verification based on the estimation of acoustic properties of carbon fiber reinforced plastics has been carried out. The developed equations adequately describes the drop in the effective elastic modulus of the specimen in accordance with the numerical simulation. The strength corresponds to a sharp drop in the elastic modulus due to damage accumulation and agrees with the experimental data.
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